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1. A security article comprising:
- a light transmissive substrate having a first surface and an opposing second surface, the first surface having an optical interference pattern; and
- a color shifting optical coating on the second surface of the substrate, the optical coating providing an observable color shift as the angle of incident light or viewing angle changes.
2. The security article of claim 1, wherein the substrate is composed of a plastic material.
3. The security article of claim 2, wherein the plastic material is selected from the group consisting of polyethylene terephthalate, polycarbonate, polyvinyl chloride, polyacrylates, polyacrylonitrile, polystyrene, polypropylene, polynaphthalene terephthalate, and mixtures or copolymers thereof.
4. The security article of claim 1, wherein the optical interference pattern is a diffraction grating pattern or a holographic image pattern.
5. The security article of claim 1, wherein the color shifting optical coating is a multilayer optical interference film including an absorber layer on the second surface of the substrate, and a dielectric layer on the absorber layer.
6. The security article of claim 1, wherein the color shifting optical coating is a multilayer optical interference film including an absorber layer on the second surface of the substrate, a dielectric layer on the absorber layer, and a reflector layer on the dielectric layer.

**Figure 1**

**ATTORNEYS AT LAW**

1000 EAGLE GATE TOWER

60 EAST SOUTH TEMPLE

SALT LAKE CITY, UTAH 84111

Docket No. 13676.142

1 9. A security article comprising:

2 a light transmissive substrate having a first surface and an opposing second  
3 surface, the first surface having a diffraction grating pattern or a holographic image  
4 pattern; and

5 a color shifting multilayer optical film on the second surface of the substrate,  
6 the optical film comprising:

7 an absorber layer on the second surface of the substrate;

8 a dielectric layer on the absorber layer; and

9 a reflector layer on the dielectric layer;

10 wherein the optical film coating provides an observable color shift as the  
11 angle of incident light or viewing angle changes.

12  
13 10. The security article of claim 9, wherein the absorber layer comprises a  
14 material selected from the group consisting of chromium, nickel, palladium, titanium,  
15 vanadium, cobalt, iron, tungsten, molybdenum, niobium, ferric oxide, carbon, and  
16 combinations or alloys thereof.

17  
18 11. The security article of claim 9, wherein the absorber layer has a physical  
19 thickness of about 30 Å to about 150 Å.

20  
21 12. The security article of claim 9, wherein the dielectric layer has an index of  
22 refraction of about 1.65 or less.  
23  
24  
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13. The security article of claim 12, wherein the dielectric layer comprises a material selected from the group consisting of silicon dioxide, aluminum oxide, magnesium fluoride, aluminum fluoride, cerium fluoride, lanthanum fluoride, sodium aluminum fluorides, neodymium fluoride, samarium fluoride, barium fluoride, calcium fluoride, lithium fluoride, and combinations thereof.

14. The security article of claim 9, wherein the dielectric layer is composed of an organic material.

15. The security article of claim 9, wherein the dielectric layer comprises a material selected from the group consisting of acrylates, perfluoroalkenes, polytetrafluoroethylene, fluorinated ethylene propylene, and combinations thereof.

16. The security article of claim 9, wherein the dielectric layer has an index of refraction of greater than about 1.65.

17. The security article of claim 16, wherein the dielectric layer comprises a material selected from the group consisting of zinc sulfide, zinc oxide, zirconium oxide, titanium dioxide, carbon, indium oxide, indium-tin-oxide, tantalum pentoxide, ceric oxide, yttrium oxide, europium oxide, iron oxides, hafnium nitride, hafnium carbide, hafnium oxide, lanthanum oxide, magnesium oxide, neodymium oxide, praseodymium oxide, samarium oxide, antimony trioxide, silicon carbide, silicon nitride, silicon monoxide, selenium trioxide, tin oxide, tungsten trioxide, and combinations thereof.

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ATTORNEYS AT LAW

ATTORNEYS AT LAW  
1000 EAGLE GATE TOWER

1000 LAUREL CANYON TOWER  
60 EAST SOUTH TEMPLE ST.

SAITAKE CITY ITHA 84111

22. The security article of claim 9, wherein the reflector layer has a physical thickness of about 300 Å to about 1000 Å.

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WORKMAN, NYDEGGER & SEELEY  
A PROFESSIONAL CORPORATION  
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1000 EAGLE GATE TOWER  
60 EAST SOUTH TEMPLE  
SALT LAKE CITY, UTAH 84111

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23. A security article comprising:

a light transmissive substrate having a first surface and an opposing second surface, the first surface having a diffraction grating pattern or a holographic image pattern; and

a color shifting optical coating on the second surface of the substrate, the optical coating including a polymeric medium and a plurality of color shifting multilayer optical interference flakes dispersed in the polymeric medium, each of the interference flakes comprising at least an absorber layer and a dielectric layer; wherein the optical coating provides an observable color shift as the angle of incident light or viewing angle changes.

24. The security article of claim 23, wherein each of the flakes has a dimension on any surface thereof ranging from about 2 to about 200 microns.

25. The security article of claim 23, wherein each of the flakes further comprises a reflector layer.

1           26.    A security article comprising:

2                   a light transmissive substrate having a first surface and an opposing second  
3                   surface, the first surface having a diffraction grating pattern or a holographic image  
4                   pattern; and

5                   a color shifting pigment dispersed within the substrate and comprising a  
6                   plurality of multilayer optical interference flakes, each of the interference flakes  
7                   comprising at least an absorber layer and a dielectric layer, the pigment providing an  
8                   observable color shift as the angle of incident light or viewing angle changes.

9  
10           27.    The security article of claim 26, wherein each of the flakes has a dimension  
11           on any surface thereof ranging from about 2 to about 200 microns.

12  
13           28.    The security article of claim 26, wherein each of the flakes further comprises  
14           a reflector layer.

- 1           29.    A method of forming a security article, comprising the steps of:
- 2                providing a light transmissive substrate having a first surface and an opposing
- 3                second surface, the first surface having an optical interference pattern; and
- 4                forming a color shifting optical coating on the second surface of the substrate,
- 5                the optical coating providing an observable color shift as the angle of incident light
- 6                or viewing angle changes.
- 7
- 8           30.    The method of claim 29, wherein the substrate is composed of a plastic
- 9                material.
- 10
- 11           31.    The method of claim 30, wherein the plastic material is selected from the
- 12                group consisting of polyethylene terephthalate, polycarbonate, polyvinyl chloride,
- 13                polyacrylates, polyacrylonitrile, polystyrene, polypropylene, polynaphthalene terephthalate,
- 14                and mixtures or copolymers thereof.
- 15
- 16           32.    The method of claim 29, wherein the optical interference pattern is formed
- 17                by embossing a diffraction grating pattern or a holographic image pattern on the first surface
- 18                of the substrate.
- 19
- 20           33.    The method of claim 29, wherein the color shifting optical coating is formed
- 21                by depositing an absorber layer on the second surface of the substrate, and depositing a
- 22                dielectric layer on the absorber layer.
- 23
- 24           34.    The method of claim 33, further comprising the step of depositing a reflector
- 25                layer on the dielectric layer.
- 26



1           35.     The method of claim 34, wherein the absorber layer, the dielectric layer, and  
2 the reflector layer are each deposited by physical vapor deposition.

3  
4           36.     The method of claim 29, wherein the color shifting optical coating is formed  
5 by applying a color shifting ink comprising a plurality of multilayer optical interference  
6 flakes dispersed in a polymeric medium to the second surface of the substrate.

7  
8           37.     The method of claim 29, wherein the color shifting optical coating is formed  
9 on the second surface of the substrate by coextruding a color shifting material, comprising  
10 a plurality of multilayer optical interference flakes dispersed in a polymeric medium, with  
11 a material forming the substrate.

12  
13          38.     The method of claim 29, further comprising the step of forming a release layer  
14 on the substrate.

15  
16          39.     The method of claim 38, further comprising the step of hot stamping the  
17 security article to an object.

18  
19          40.     The method of claim 29, further comprising the step of attaching the security  
20 article to an object.

21  
22          41.     The method of claim 40, wherein the object is selected from the group  
23 consisting of security documents, monetary currency, credit cards, and merchandise  
24 packaging.

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1 42. A security article comprising:

2 a light transmissive substrate having a first surface and an opposing second  
3 surface, the first surface having a diffraction grating pattern or a holographic image  
4 pattern; and

5 a color shifting multilayer optical film on the first surface of the substrate, the  
6 optical film comprising:

7 an absorber layer on the first surface of the substrate; and

8 a dielectric layer on the absorber layer;

9 wherein the optical film provides an observable color shift as the angle of  
10 incident light or viewing angle changes

11  
12 43. The security article of claim 42, wherein the substrate is composed of a plastic  
13 material.

14  
15 44. The security article of claim 42, wherein the optical film further comprises  
16 a reflector layer on the dielectric layer.

17  
18 45. The security article of claim 42, wherein the absorber layer comprises a  
19 material selected from the group consisting of chromium, nickel, palladium, titanium,  
20 vanadium, cobalt, iron, tungsten, molybdenum, niobium, ferric oxide, carbon, and  
21 combinations or alloys thereof.

22  
23 46. The security article of claim 42, wherein the wherein the dielectric layer  
24 comprises a material selected from the group consisting of silicon dioxide, aluminum oxide,  
25 magnesium fluoride, aluminum fluoride, cerium fluoride, lanthanum fluoride, sodium  
26

1 aluminum fluorides, neodymium fluoride, samarium fluoride, barium fluoride, calcium  
2 fluoride, lithium fluoride, and combinations thereof.

3  
4 47. The security article of claim 42, wherein the dielectric layer is composed of  
5 an organic material.

6  
7 48. The security article of claim 42, wherein the dielectric layer comprises a  
8 material selected from the group consisting of zinc sulfide, zinc oxide, zirconium oxide,  
9 titanium dioxide, carbon, indium oxide, indium-tin-oxide, tantalum pentoxide, ceric oxide,  
10 yttrium oxide, europium oxide, iron oxides, hafnium nitride, hafnium carbide, hafnium  
11 oxide, lanthanum oxide, magnesium oxide, neodymium oxide, praseodymium oxide,  
12 samarium oxide, antimony trioxide, silicon carbide, silicon nitride, silicon monoxide,  
13 selenium trioxide, tin oxide, tungsten trioxide, and combinations thereof.

14  
15 49. The security article of claim 44, wherein the reflector layer comprises a  
16 material selected from the group consisting of aluminum, silver, copper, gold, platinum,  
17 palladium, nickel, cobalt, tin, niobium, chromium, and combinations or alloys thereof.

18  
19 50. The security article of claim 44, wherein the reflector layer is composed of  
20 a magnetic material.

21  
22 51. The security article of claim 42, further comprising a release layer on the  
23 second surface of the substrate.

24  
25 52. The security article of claim 42, further comprising an adhesive layer on the  
26 optical film.